The Earth is a Giant Magnet

Standards Statement:
3.1.7.B – Describe and use models as an application of scientific or technological concepts.
3.1.7.E – Identify change as a variable in describing natural and physical systems.
3.2.7.A – Explain and apply scientific and technological knowledge.
National Standard:
- Know that magnets attract and repel each other and attract certain kinds of other materials.
Content Objective:
Students will be able to:
1. Explain the force of magnetism as it relates to Earth
2. Describe the forces of attraction and repulsion.
3. Describe why magnetism is a "Universal Force."
4. Explain the reason for constructing the shuttle of a nonmagnetic material.
Process Objective:
Students will be able to:
1. Create hypotheses concerning effect of the Earth's magnetic field on object entering the magnetosphere.
2. Predict the impact of magnetic objects on charged particles within Earth's magnetosphere.
Assessment Strategies:
1. Scientific Drawing.
2. Scientific Observation.
3. Written response to questions.
Procedures:
1. Introduce ideas of magnetism, Earth's Magnetosphere, lines of force, poles, magnetic field, magnetic domains, and magnetic materials.
Information available at:
www.liftoff.msfc.nasa.gov/academy/space/mag_field.html

Suggested Level:
Intermediate/Secondary

Standard Category:
3.1 – Unifying Themes
3.2 – Inquiry and Design

Materials:
Bar magnets
Small magnets
Large paper clips
Iron fillings
White paper

Instructional Strategies:
Discussion
Inquiry
Cooperative Learning

Related Concepts:
Observation
Hypothesizing
Predicting
Written Communication
Scientific Drawing

The Earth is a Giant Magnet
An investigation to explore the affects of magnetic fields on magnetic metals.

Thought questions to begin:
What affects do magnets have on charged particles?
What materials would you use to construct a space shuttle? What properties do these materials possess that contributed to your choices?

Investigation:
To investigate the force of magnetism and its impact on magnetic metals follow the following instructions carefully:
1. Obtain a bar magnet. This will be used to represent the Earth as a magnet.
2. Place a sheet of white paper on your desk. Place your bar magnet in the middle of this paper.
3. Carefully sprinkle iron fillings around your bar magnet. Record your observations in the space provided.
4. Create a scientific drawing of your magnet and fillings. Carefully label the poles and the magnetic field. Label the area where the magnetic field is strongest and weakest.
5. Obtain a second smaller magnet. Carefully slide this magnet perpendicularly into the magnetic field of the first magnet.
6. Record your observations in the space provided. Create a scientific drawing of these magnets and fillings. Be careful to label all areas of significance.
7. Remove the second magnet. Move bar magnet around to recreate "lines of force."
8. Obtain a paper clip. Uncoil the clip. Slide the paper clip perpendicularly into the magnetic field of the bar magnet. Record all observations and create a scientific drawing of your observations.
9. Remove the paper clip. Carefully stroke the clip in one direction with a bar magnet. Carefully slide the clip into the magnetic field of the bar magnet. Record all observations and create a scientific drawing of your observations.

Questions to ponder:

1. Why can the Earth be referred to as a dipole?
2. What are the designations for the ends of a magnet?
3. What are magnetic field lines of force? Where do they originate?
4. What areas of a magnet attract? Repel?
5. Based on your observations, what would happen if a magnetic metal was moving through the Earth's magnetic field?
6. What is the composition of the Earth's core? Are these materials magnetic? How do you think that the movement within the core impacts the Earth's magnetic field?
7. Why is magnetism considered a universal force?
8. What did you observe as you sprinkled iron fillings around your magnet?
9. What did you notice about the lines of force that formed around the poles of your magnet? How did the concentration compare to the iron fillings in the center of the magnet?
10. What does this indicate about the strength of the magnetic forces? Where is this force the strongest? The weakest?
11. Would you direct a space shuttle to return to the Earth at a location close to a magnetic pole? Explain your reasoning.
12. If the iron fillings represent the charged particles in the Earth's atmosphere, what would a magnetic object entering the atmosphere create?
13. What is a magnetic domain? What types of materials are magnetized?
14. What can you do to magnetize an un-magnetized material? Do you think that this process will work on all matter? Explain your reasoning.
15. Would astronauts be able to use a compass to navigate their direction? Explain.

Observation #1: Bar magnet and iron fillings

Scientific Drawing #1: Bar magnet and iron fillings

Observation #2: Magnet entering magnetic field of bar magnet

Scientific Drawing #2: Magnet entering magnetic field of bar magnet

Observation #3: Un-magnetized paper clip entering magnetic field of bar magnet

Scientific Drawing #3: Un-magnetized paper clip entering field of bar magnet

Observation #4: Magnetized paper clip entering magnetic field of bar magnet

Scientific Drawing #4: Magnetized paper clip entering magnetic field of bar magnet

Scientific Drawing

Name _____Date _____ Course/Class _____

Task/Assignment _____

Expert 4	The drawing(s) realistically and effectively depicts the object(s). Multiple perspectives are provided to enhance understanding. A descriptive and accurate title is provided and all the parts of the drawing are clearly labeled. A detailed, written explanation of what the scientific drawing is intended to show is included, along with a key or legend to further explain the drawing(s). The drawing(s) is of an appropriate size and consistent metric scale for details to be easily recognized. . Principles of artistic composition are well employed.
Proficient 3	The drawing(s) depicts the object(s). Many details are included. A descriptive and accurate title is provided and most parts of the drawing are clearly and neatly labeled. A sketchy, written explanation of what the scientific drawing is intended to show is included. The drawing(s) is of an appropriate size and scale for details to be easily recognized. Principles of artistic composition are employed.
Emergent 2	The drawing(s) reasonably depicts the object(s). The drawing(s) is a reasonable rendition of the object(s), but may include features that were not actually observed. Some details are included. Only one perspective of the object(s) is provided. A title is provided for the drawing(s). Some parts of the scientific drawing are labeled. Labeling lacks neatness, legibility, and attractiveness. A sketchy, written explanation of what the scientific drawing is intended to show is included. The drawing(s) is inappropriately sized and scaled. Principles of artistic composition are largely lacking in this drawing(s).
Novice 1	**The drawings are clearly lacking in realism, accuracy, and detail. It is difficult to tell what the drawing(s) represents. Scale and proportion are clearly lacking. Metric measurements are missing. Few distinguishing forms, structures, and details are labeled. Labeling is not consistently neat, legible, and attractive. No attempt is made to provide a title of the drawing(s). The principles of artistic composition are lacking in this drawing.**

O Comments O Goals O Actions

Observing and Inferring in Science

Name _____ Date _____ Course/Class _____

Task/Assignment _____

Performance Criteria	Assessment			
	Points	**Self**	**Teacher**	**Other(s)**
1. Observations are based upon what was actually observed and not based upon prior knowledge, personal opinion, observer bias, or inferences.				
2. Appropriate tools and materials were selected, evaluated, and then used to make the final observations.				
3. Appropriate metric measurements are used to describe quantitative observations.				
4. Observations are quantitatively and/or qualitatively accurate.				
5. Both magnitude and units are recorded for quantitative data.				
6. Observations are interpreted by comparing and contrasting objects or events.				
7. Inferences are explained and justified based upon background research, investigative data, and /or the observer's prior knowledge.				
8. Inferences fall within a range of acceptance (reasonableness) as based upon all the observations, data, and the observer's prior experience.				

O Comments O Goals O Actions

Writing to Inform in Science (Extended Constructed Response)

Name _____Date _____Course/Class_____

Task/Assignment _____

	Development	Organization	Audience	Language
Weights ⟶				
Expert 4	Development: The writer provides accurate, specific, and purposeful scientific facts and concepts that are extended and expanded to fully explain the topic.	Organization: The writer establishes an organizational plan and consistently maintains it.	Audience: The writer provides scientific information relevant to the needs of the audience.	Language: The writer consistently provides scientific vocabulary and language choices to enhance the text.
Proficient 3	Development: The writer provides scientific facts and concepts that adequately explain the topic with some extension of ideas. The information is usually accurate and purposeful.	Organization: The writer establishes and maintains an organizational plan, but the plan may have some minor flaws.	Audience: The writer provides information most of which is relevant to the needs of the audience.	Language: The writer frequently provides scientific vocabulary and uses language choices to enhance the text.
Emergent 2	Development: The writer provides scientific facts and concepts that inadequately explain the topic. The information is sometimes inaccurate, general, or extraneous.	Organization: The writer generally establishes and maintains an organizational plan.	Audience: The writer provides some information relevant to the needs of the audience.	Language: The writer sometimes provides scientific vocabulary and uses language choices to enhance the text.
Novice 1	Development: The writer provides insufficient scientific facts and concepts to explain the topic. The information provided may be vague or inaccurate.	Organization: The writer either did not establish an organizational plan or, if an organizational plan is established, it is only minimally maintained.	Audience: The writer did not provide information relevant to the needs of the audience.	Language: The writer seldom, if ever, provides scientific vocabulary and uses language choices to enhance the text.